Agency for Change Podcast: Dr. John Cooley, Chief of Products, Nanoramic Laboratories

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John Cooley

The harder a decision you make, the more value you add.

Announcer:

Welcome to Agency for Change, a podcast from KidGlov that brings you the stories of changemakers who are actively working to improve our communities. In every episode, we'll meet with people who are making a lasting impact in the places we call home.

Lyn Wineman:

As climate change accelerates, we humans are going to need more efficient, more sustainable technologies to help us reduce our impact, but the question is always how. Well, one way is to think about your car. The EPA estimates that the average passenger vehicle, which utilizes gasoline for fuel, emits about 4.6 cubic tons of CO2 per year. And since for many of us in the United States, a vehicle is the primary way we get around, it becomes a leading culprit in the fight against climate change. So what can you do?

Lyn Wineman:

Well, electric vehicles are slowly but surely becoming more affordable and more capable by the day. But one thing that continues to hold them back is battery technology. Batteries for EVs are expensive, they have a limited lifespan, and they take a long time to charge you may have noticed, much longer than filling up at a gas station. So luckily there are some very smart people working to change all of that like our guest today, Dr. John Cooley, chief of products at Nanoramic Laboratories, which is solving some of the biggest problems in energy storage and thermal management. Hey everyone, this is Lyn Wineman, president and chief strategist at KidGlov. Welcome to another episode of the Agency for Change podcast. And today I am so eager to talk to you, John. Welcome to the podcast.

John Cooley:

Thanks, Lyn. Thanks for having me.

Lyn Wineman:

Hey, I just want to start by talking about Nanoramic Laboratories. Am I pronouncing that right, Nanoramic Laboratories?

John Cooley:

Yep. You can think of it like panoramic with a nano on the beginning.

Lyn Wineman:

Oh, I love that so much. So for our listeners who may not have heard of you, can you give us an overview of what Nanoramic Laboratories does?

John Cooley:

For sure, yeah. Today we're pretty focused on lithium-ion batteries, but fundamentally the company is a product development focused corporation. So we have over time developed a number of different products under different business lines and fully culminated those. We started with a relatively niche energy storage technology called an ultracap or a supercap, and we developed and commercialized that in what we considered be an alpha market, which was oil and gas drilling. And it's somewhat ironic because we have always had aspirations of finally making it into clean tech. And then we developed products for beta markets in consumer electronics and other applications.

John Cooley:

More recently, you'll see a press release just in the last few days from an acquisition of one of our business lines that was focused on polymer composites, so a different advanced material product for thermal management. And then in the last few years we've gotten very involved in lithium-ion battery technology, having transferred our core technology from some of those earlier developments into lithium-ion batteries at a time when the electric vehicle renaissance was taking off. So, today anyway, we're focused on advanced materials products and how they enable energy storage technologies in particular. And then as a business we have a product development model that we've matured quite a bit.

Lyn Wineman:

John, I can tell just from that answer to that question that you are a slacker. Just kidding there, of course. Because I'd love to just step back and talk about you for a minute. I read somewhere in your background that you have five degrees from MIT, which includes your PhD. I'm just curious what inspired your passion for this field and pushed you to that level of work to obtain those degrees?

John Cooley:

It's almost like a fun fact having counted up the degrees that I ended up with. I spent about 10 years at MIT not really with the intention of doing all that. I started as a physics major following in my brother's footsteps. He's a physicist, he went to Caltech a few years before I went to college, and I really liked physics in high school. And then halfway through my undergraduate career, I found that I was more attracted to work that was focused on hands on electronics design and systems, and that's partly just because I've always been very intrigued and motivated by the idea that you can cobble together electronic components and make it do something useful for you. So when I went to find research opportunities, I gravitated there, and I ended up adding on an electrical engineering degree. The professor who I worked for as an undergrad asked me to stay on to do a master's degree, and then there's an additional degree beyond that, that you can earn if you go above and beyond a standard master's degree. And then I ended up staying for a PhD.

John Cooley:

That whole time, especially as a graduate student, at least I would say in the better experiences, you're given a very open-ended work environment maybe with some guidance on new ideas and things to explore. And at the end of the day, you end up spending that time just thinking, thinking about problems at their most basic level, how you can make connections between different disciplines, and all of that

leads to just a different habit about how you approach problems. But also as a graduate student, having been at MIT for so long, I started to become a little bit restless.

John Cooley:

And this was at a time when we were coming out of the recession in 2008, and in 2009 there was a lot of focus on clean technology development and applications. There was actually a lot of government funding that was becoming available to fund some of those things. And I thought that a very good way for me to focus a lot of the different things that I had been working on was to apply them to clean energy problems. And so my PhD thesis focused on some of those things. And it's a lot of different solutions and analyses on how to interface energy storage devices with power systems and different renewable energy sources, solar and other sources of clean energy.

Lyn Wineman:

It seems like your timing was really good in that the light was being shown on clean energy, but it seems like the exclamation point has come out in the last year and a half really becoming very serious with almost a deadline for us in the next nine, 10 years, really getting serious about this.

John Cooley:

Yeah, so what happened in 2009 was that myself and a lab-mate, we ended up writing a government funding proposal to the Department of Energy, which was the first open funding opportunity announcement for energy storage technology under the DoE's ARPA-E, and we won that. And so it was a five and a half million dollar grant. And we had written this proposal in the basement of MIT and pretty quickly got started with the company. So because of that grant, we always had these aspirations for clean tech applications and markets. To your point about timing, at the time, those markets really didn't exist. And even as a small company, we knew we couldn't immediately penetrate high volume markets like that, and so that's where the alpha and beta market concepts came from. But the secret behind that, at least in my mind, was, well, if we're going to get into oil and gas drilling, we can enjoy the proceeds from that business to fund full irony, and we have done that.

John Cooley:

So we are at the point now today where everything has aligned. So we've culminated products in those first markets, we're benefiting from revenue streams from those technologies and markets, and we are actively using that to fund product development for clean technology applications. And the environment that we're in today, political, social, technical, commercial environment that we're in today is a reality that was one possible scenario we could have imagined, and there are many others. I don't think we should take for granted, for instance, the fact that Tesla decided that they were going to show there's a proof of concept for a commercializable electric vehicle, and they have done that. I think that we can all be glad and happy that societal pressures have really made an impact on policy and even on the behavior of well-established manufacturers.

John Cooley:

We shouldn't take that for granted either, but from a business and policy standpoint it's definitely all aligned. And then in miraculous fashion, our technology, the IP and innovation that we've matured over the last 10 years has really come just almost coincidentally to a point that it perfectly aligns with all of that as well. As I mentioned, we were able to transfer a lot of those core innovations from some of the other technologies we developed under various grant programs, commercial contracts for different

markets. We were able to transfer that in a very unique and exciting way into lithium-ion batteries right at the right time.

Lyn Wineman:

John, I love the use of the phrase miraculous fashion and how it all came together, but I'm also a firm believer, just as you mentioned Tesla going out, and I think people like you that have the courage to step forward before there's even a clearly defined path for how it's all going to work out. I think that's a really, really important thing. So as we've talked, we've used the phrase clean technology several times, and while I feel like I understand what clean technology is, I'm guessing somebody like you who's in the field can describe it at an even higher and more accurate level. Would you do that for us?

John Cooley:

And sometimes we throw these words around interchangeably and loosely, renewable and clean tech in particular, but if you actually think about what those words mean, there's some nuances. So renewable means something a little bit different from clean, but they tend to overlap. Renewable means that it's in some ways non-depleting. I would say that the best example of that is solar. We don't expect the sun to stop shining anytime soon. So that's a very good example of a renewable energy source. It doesn't necessarily mean that it's a clean energy source. You might consider other sources that are also non-depleting, not clean. If you were to use your imagination and think maybe natural gas is renewable because there's just enough of it, we'll never run out, well, it's definitely not clean. So there's an example where renewable may not be considered clean. Clean pretty specifically means that it doesn't produce greenhouse gas emissions.

John Cooley:

And that's actually complex and nuanced itself, because the concept that we talk about today is what is your CO2 footprint, or maybe more broadly, what is your greenhouse gas emissions footprint. For example, to go back to solar, while the energy source is renewable, the energy source is clean, but building the solar panels, transporting the solar panels, installing the solar panels, that process has most likely in all cases a non-zero greenhouse gas emissions footprint. So I think this is one of the useful frameworks that has come out, especially I would say in some of the regulations and discussion in the European Union regarding some legislation about CO2 footprint and the overall product life cycle specifically for batteries and electric vehicles. If you think about what is the CO2 footprint for the total life cycle of this technology, it really helps you think about that properly.

Lyn Wineman:

I appreciate that, because I think we've all been in conversations where there's a little bit of debate about electric vehicles, and batteries are always the thing that comes up, that the batteries are maybe not as clean to produce. I might even be using that language the wrong way, and you can help me clarify that. But I'm even curious, John, what are some of the ethical and environmental considerations of creating the electric batteries today? And I guess too, how are you working to address those concerns?

John Cooley:

For sure. Any manufacturing process will consume energy, and so when you think about whether or not that manufacturing process is clean from an emissions perspective, you think about how much energy it consumes and where the energy is coming from. And then there are other interpretations of clean, we might consider these more environmental aspects like what are the different chemicals or materials that

are in the process? And then what are the chemicals and materials that are byproducts or waste products of the process? When we think about battery manufacturing, there are energy intensive steps in that process, especially in one of the... And this is a little technical, but the coding process, and in particular, the drying process within the coding process for one of the two electrodes that go into a lithium-ion battery, that process is pretty energy intensive. If the energy for that process comes from a coal-fired plant, that is pretty dirty, that's a dirty manufacturing process from a greenhouse gas emissions perspective.

John Cooley:

What I would say is one of the nice things that's happening with all of the attention and momentum that's happening in the electric vehicle space, there's almost quietly, and when I say that, relatively speaking from a pop media perspective, the grid has become cleaner and is becoming cleaner over time. That's been driven by economics of the wind and solar becoming more favorable compared to other sources. I was telling somebody the other day that I was driving from Houston to south Texas a few months ago, and there are stretches of that drive where you cannot see the end of the wind farms, and meanwhile you're driving next to trucks that are transporting turbine blades for more wind turbines. I think that Texas is somewhere at 20% total capacities attributed to winds these days, and growing. And the US overall is somewhere around 10%.

Lyn Wineman:

I recently drove through Wyoming and had a similar experience where it's like, "Oh my goodness, it's just overwhelming almost to look around and see all the turbines."

John Cooley:

That's right. But anyway, that's a little bit of a digression. That's how you can think about the greenhouse gas emissions from a battery manufacturing process or any manufacturing process. The other clean aspects of the process from a material standpoint, there are solvents that are used to dissolve certain materials, there are vapors that come from the drying process and we want to pay attention to those. And then from an ethical consideration, there has been a lot more attention in the last year or so about alternate chemistries to address the problems that come with sourcing particular materials, especially on one of the two electrodes in the battery and where they come from. So one of the popular chemistries, or the most popular chemistry today, is called NMC, and the N stands for nickel, and the C stands for cobalt, and the nickel to a large extent comes from Russia, and the cobalt to a large extent comes from the DCR, the Democratic Republic of Congo. DRC, sorry.

John Cooley:

There are different and almost obvious ethical reasons why those are problems. And also with the passing of the Inflation Reduction Act, there's been more amplification of focus on alternative chemistries to NMC. And one in particular is called LFP, so that stands for lithium iron phosphate. There are advantages to that, from a supply chain standpoint, the materials are more abundantly sourced. And then there are drawbacks to that chemistry, must notably on performance. So that's the lay of the land I would say and then the way that our technology addresses some of those issues. So our technology is called Neocarbonix, and one of the core innovation is the elimination of the most limiting material inside of the battery, and that's this binder system, it's a binder, it's a plastic, its only purpose is to hold together the different active materials on the electrodes and also hold them to the foil.

John Cooley:

And we've out of necessity had to innovate that material out of energy storage devices over the years to accommodate very harsh environments where that material would otherwise break down, and we've had to develop electrodes and manufacturing processes to do that practically and with risk mitigated supply chain. I think we are the only ones to have done this, and we've replaced that material with 3D nano-carbon mesh, and we apply it both to cathode and anodes, so both electrodes in inside of the battery, with different but similar benefits on each electrode. And by the way, we've done all this, but in a way that we have been able to reuse existing manufacturing equipment. So essentially what we were able to do is update existing manufacturing processes to eliminate this material. And then the benefits fall into three big buckets. One is performance, the second is cost, and the third is sustainability.

John Cooley:

From a sustainability standpoint, to address your question, one of the benefits is that we eliminate a solvent from the process that is very difficult to drive, it requires a lot of energy to dry. And by doing that, we reduce the drying energy consumption in the process by 75%. And at a battery plant level, from powder to cell, that reduces overall battery plant energy consumption by 25%. And that is about half a million metric tons of carbon dioxide emissions reductions per year per gigafactory. So that's just the straight greenhouse gas emissions impact on the manufacturing process.

John Cooley:

That solvent is also a very toxic solvent that you really don't want to have around. It's been identified by the US EPA as an unreasonable risk to workers, and it's about to be severely regulated in the European Union as well. We eliminate that solvent, we replace it with either water or alcohol-based solvents, depending on the customer's preference. And those solvents are much easier to dry. Our CTO likes to say—you put our electrode on the table and it just dries on its own. You almost don't even need an active oven. You can use a heat pump in some cases just to run the oven to dry this electrode. You could cool a facility, in other words, to dry the electrode. So that's another clean aspect, but a different interpretation of the word clean.

Lyn Wineman:

John, as you are going deep into batteries here, I am having a flashback to seventh grade science when I had to make a battery from scratch, and I'm pretty sure mine never actually worked. So listening to you go deep into battery technology, I am fascinated by every bit of this.

John Cooley:

So we all had the potato clocks, right?

Lyn Wineman:

Yeah. My potato clock worked, but my homemade battery was a for sure failure.

John Cooley:

By the way, I'm an electrical engineer really, but one thing that I'm always fascinated by is the total inter-dimensional interplay between mundane technology choices and their effects on completely and seemingly unrelated problems like policy and climate and ethics. So I find this very fascinating what I'm talking about. So the third piece is ethics, and one of the buckets that we add value to is performance.

Now, LFP is an alternate chemistry that's very popular for supply chain reasons and for ethical considerations because you can get the materials you need for it from other places besides Russia and the Democratic Republic of Congo, for instance, but the key drawback has been performance. While our technology improves performance, it's essentially a platform technology that's transportable across chemistries. And when we apply it to LFP, we improve the performance, and we make it more sufficient for electric vehicle applications.

John Cooley:

And so in that way, by enabling LFP more broadly, we also have an ethical benefit in the supply chain. Also, there are other cathode chemistries besides LFP that limit some of those materials, and we also enable and enhance those. On the anode side, which is the other electrode, it's typically made up of graphite mostly. We've been able to enable an anode that's mostly made up of silicon rather than graphite. Today, most graphite comes from China, and so we also have this benefit for supply chain security that we eliminate the need to source a major component in the battery largely from China. What's fundamentally going on here is that we have been able to relax the design constraints on the battery chemistry. And in doing that, we have all this extra flexibility that impacts ethics and the energy consumption and the battery manufacturing process, and all these things.

Lyn Wineman:

John, I'm glad that there are smart people like you and your team that are figuring this out for the entire human race here. I'm curious, we've gone so deep into the work that you're doing and the importance of it, what lies ahead? What do you see as you tackle these problems that are right in front of us and find the sources and improved performance, cost and sustainability, what happens in the next 10 to 15 years?

John Cooley:

There's a lot of concern about climate change. There was a lot of concern about transitions that we're making from internal combustion engines to electric vehicles, from old sources of grid based energy to new sources of grid based energy or maybe revamping other sources that we've downplayed. I actually watched a documentary, a Patagonia film the other day, and the idea was to reframe that conversation from one of worry and blame to one of hope and optimism. And I relate to that because I think we can be optimistic. I view this as a very interesting problem and I am optimistic that there are a few things going in our favor. And I said we shouldn't take this for granted, but one is that there's been a ton of impact from societal pressure on real manufacturers to make changes.

John Cooley:

It's just a lot easier for Volkswagen to start pitching that they're going to convert to 100% electric in a short period of time than it is for them to continue selling internal combustion engines. It's just better, it's accepted, it's easier for them to make that decision. And I also think there's a nuance that's going to happen in the transition that is being either ignored or not acknowledged, which is that these auto manufacturers, they make a relatively slim profit margin. It's not super slim, but it's relatively slim. And they do it with a very sophisticated operation that starts with development and transition to manufacturing and very careful quality control and cost control. And when you introduce electric vehicles as an alternate technology, you're asking them to basically run that for two different businesses, and that's not practical.

Lyn Wineman:

Yeah. I think maybe people don't realize that it's more than just a different model. It's a completely different business unit.

John Cooley:

That's right. That's a detail, but it's an example of something we can be optimistic about. I think in general there's a lot of momentum and a lot of engineering and problem solving that's going on specifically for electric vehicle adoption, but there's more than one problem that needs to be addressed, and I think of it in five different subjects. One is electric vehicles, two is grid-based energy or power production, three is heavy industry, and four is agriculture, and then five is the direct recapturing of greenhouse gas emissions from the environment.

John Cooley:

One thing that I think has just happened recently has been the passing of the Inflation Reduction Act. And something I like about that legislation is that it addresses all five of those topics. So I think that's very positive. I do think we could be a little more imaginative. All these things that I've described are great and we shouldn't take them for granted. And again, I think we can be optimistic starting from there. I think we can still be more imaginative about policies or plans to address the climate emergency more abruptly and urgently, but I think we're at a nice, almost like a mezzanine stopping point where we've got to say, "This is a good start."

Lyn Wineman:

Those are two terms that don't go together in my brain, imaginative and policy, because, gosh, sometimes it seems like by the time policy gets passed, it's gone through so many hands and filters and refinements and approval process and committees. We all know that process can really just take all of the imagination out of something. So it's good to know that there are people who are pushing for that and who are thinking about that. John, I also appreciate your optimism, because I think you could get wrapped up in this whole topic and just become a doom and gloom person. And I think the optimistic part of this is where the imagination comes from. So I'm going to ask you a totally different question, and people who listen to Agency for Change know that this is my favorite question and that is could you provide us a few of your own words of wisdom to inspire our listeners? So an original John Cooley quote.

John Cooley:

One quote, and I don't know if this is specifically related to being optimistic about climate change and the progress that we're going to make and that we are making, but one thing that I like to say is that the harder a decision you make, the more value you add. This is something that I go back to a lot when I am trying to figure out how to focus my attention and energy, either on day-to-day operations or on how the business should move forward. It might apply to things like, "Well, how hard is the problem that we're tackling on the technology side?" Because really that's where the value is going to be added either to the company or to the industry, or both. And in a lot of ways, it's fundamentally how you establish your competitive advantage as a company.

John Cooley:

It also applies to operational things like what are the problems inside of the organization that we need to fix, and a lot of times you're not fixing them because the decisions you have to make are difficult. That probably means that it's a difficult problem and if you make the decision, you're going to add a lot of

value. So I like that just because it boils a lot of things down to how can you prioritize your efforts even day to day.

Lyn Wineman:

Fantastic. John, for our listeners who would like to learn more about your work, how can they find out about Nanoramic Laboratories?

John Cooley:

We're pretty active from a marketing standpoint on LinkedIn. You can also find our website nanoramic.com, you can go there, you can look at our press releases. We will have some press coming out about a success that we've had on one of our other business lines recently. So you can go to our careers page, we are hiring, we're always looking for talented folks, especially in the electric vehicle battery space. And you can find me on LinkedIn and connect with me directly if you'd like to chat.

Lyn Wineman:

Fantastic. John, we'll make sure we have links to your website and your LinkedIn pages in our show notes on kidglov.com as well. As we wrap up our time together today, and this has been such a fascinating conversation, what is the most important thing you would like our listeners to remember about the work that you're doing?

John Cooley:

The work that we're doing is specifically focused on impacting climate change from a technology standpoint, and everything that we do about it is intended to do that as rapidly as possible. Both the technology and the business model are designed to rapidly commercialize and scale with the technology. So you'll see that in the way that we approach our market. We have designed the technology to reuse existing manufacturing equipment, and we've designed the business model to partner with established manufacturers because our goal is to get this technology into vehicle platforms as soon as possible. We believe it's going to expand and accelerate EV adoption, and it's going to reduce the energy consumption in the battery manufacturing process and make that process safer for the workers.

Lyn Wineman:

Fantastic. John, I have loved this conversation. I fully believe the world needs more people like you and more organizations doing the good work like Nanoramic Laboratories is. And I just thank you for sharing with us today.

John Cooley:

Well, Lyn, thanks a lot for having me. I enjoyed the conversation as well.

Announcer:

We hope you enjoyed today's Agency for Change podcast. To hear all our interviews with those who are making a positive change in our communities, or to nominate a changemaker you'd love to hear from, visit KidGlov.com at K-I-D-G-L-O-V.com to get in touch. As always, if you like what you've heard today, be sure to rate, review, subscribe, and share. Thanks for listening, and we'll see you next time.